High Level Architecture Implementation in the Navy's Battle Force Tactical Training Program

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HLA Implementation in BFTT

Outline

- BFTT Concept
- BFTT Software Architecture
- Goal: Interoperability
- HLA Implementation Options
- Summary

HLA Implementation in BFTT

BFTT Concept

- BFTT is an In-port Ship Combat Team Training System
  - Combat Systems Become Virtual Trainers
  - Able to Train Where They Fight
- BFTT is a federation of federations:
  - a federation of multi-warfare combat systems on a ship
  - a federation of ships in a Battle Group / Amphibious / Ready Group

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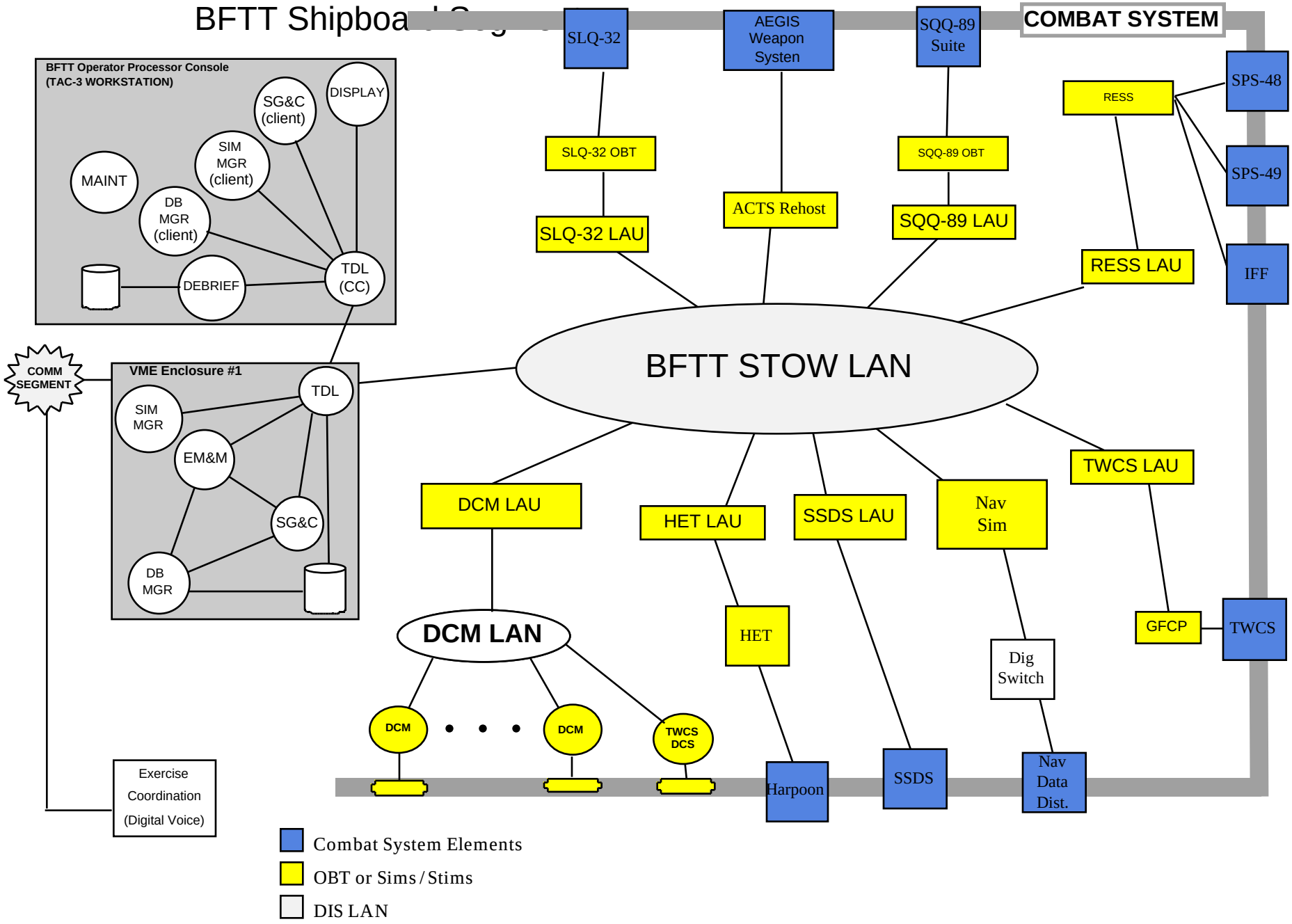
BFTT Concept

- Federation of Ship Combat Systems
  - Ship Combat Systems Sensors are stimulated via Onboard Trainers (OBTS)
  - Stand alone OBTs are networked via LAN Access Units and coordinated by a scenario generation and control capability
  - Data are collected of trainee actions and are processed into immediate feedback reports of performance


BFTT Shipboard
COMBAT SYSTEM
SLQ-32
AEGIS Weapon Systen
SQQ-89 Suite
SPS-48
SPS-49
IFF
RESS
BFTT Operator Processor Console (TAC-3 WORKSTATION)
SG&C (client)
DISPLAY
SIM MGR (client)
MAINT
DB MGR (client)
TDL (CC)
DEBRIEF
SLQ-32 OBT
SQQ-89 OBT
SLQ-32 LAU
ACTS Rehost
SQQ-89 LAU
RESS LAU
BFTT STOW LAN
COMM SEGMENT
VME Enclosure #1
TDL
SIM MGR
EM&M
SG&C
DB MGR
DCM LAU
HET LAU
SSDS LAU
Nav Sim
TWCS LAU
DCM LAN
HET
GFCP
TWCS
Dig Switch
DCM
DCM
TWCS DCS
Harpoon
SSDS
Nav Data Dist.
Exercise Coordination (Digital Voice)
Combat System Elements
OBT or Sims / Stims
DIS LAN

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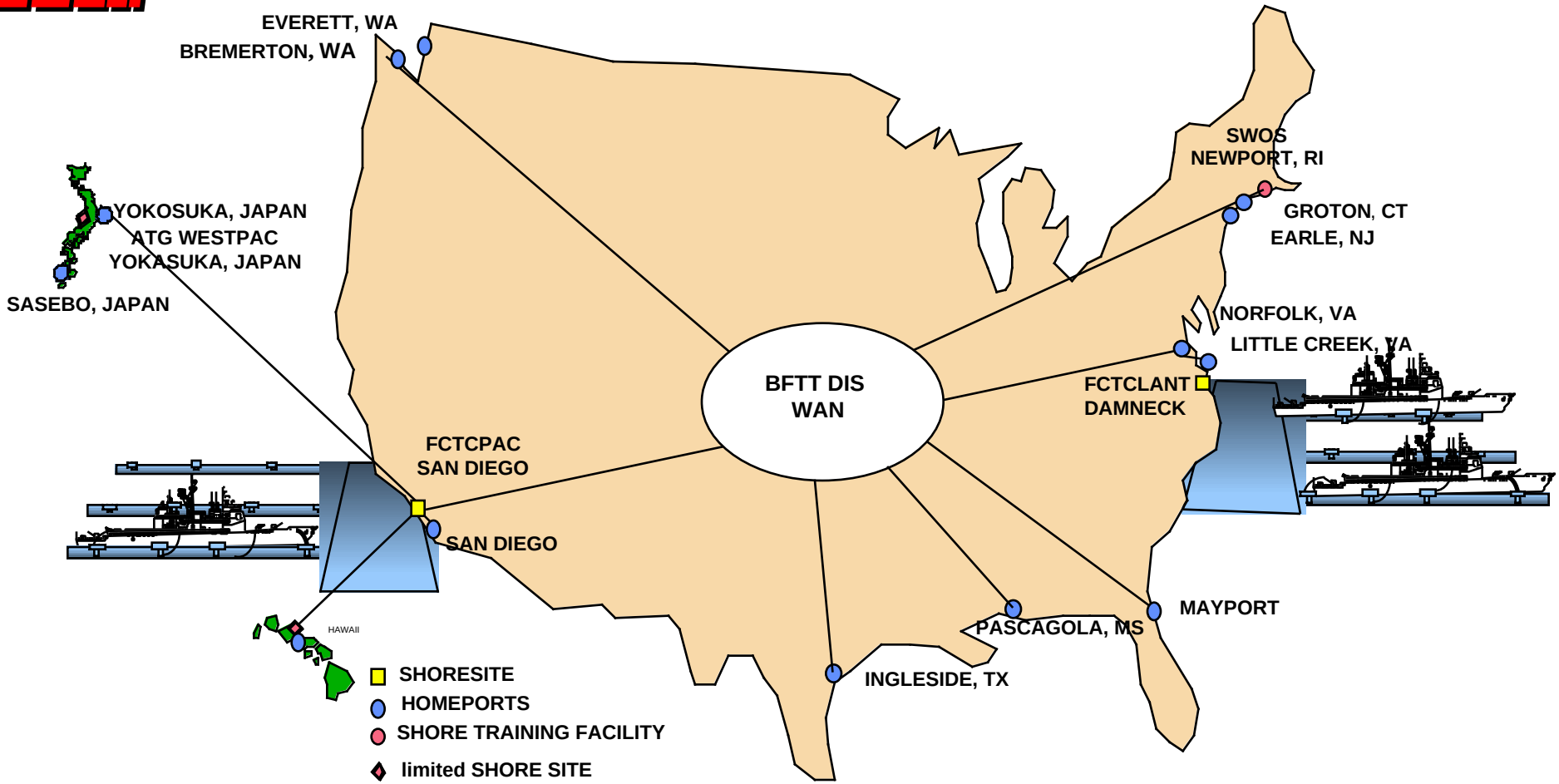
BFTT Concept cont.

- Federation of ships
  - Ships are linked in port via wireless LANs
  - Ships are linked in disparate ports via DSI
  - Shore sites at FCTCLANT and FCTCPAC act as exercise control nodes


EVERETT, WA
BREMERTON, WA
SWOS
NEWPORT, RI
GROTON, CT
EARLE, NJ
YOKOSUKA, JAPAN
ATG WESTPAC
YOKASUKA, JAPAN
SASEBO, JAPAN
NORFOLK, VA
LITTLE CREEK, VA
BFTT DIS
WAN
FCTCLANT
DAMNECK
FCTCPAC
SAN DIEGO
SAN DIEGO
MAYPORT
PASCAGOLA, MS
INGLESIDE, TX
HAWAII
SHORESITE
HOMEPORTS
SHORE TRAINING FACILITY
limited SHORE SITE

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BFTT Software Architecture

- Object Oriented DIS Paradigm
  - » Encapsulated CSCI in Common Communications (CC) Infrastructure
  - » Common Communications Infrastructure Data Messages are DIS Based
- Allows Adaptation to Changing Requirements
- The CC allows each software component to execute independent of language, structure, design of other components

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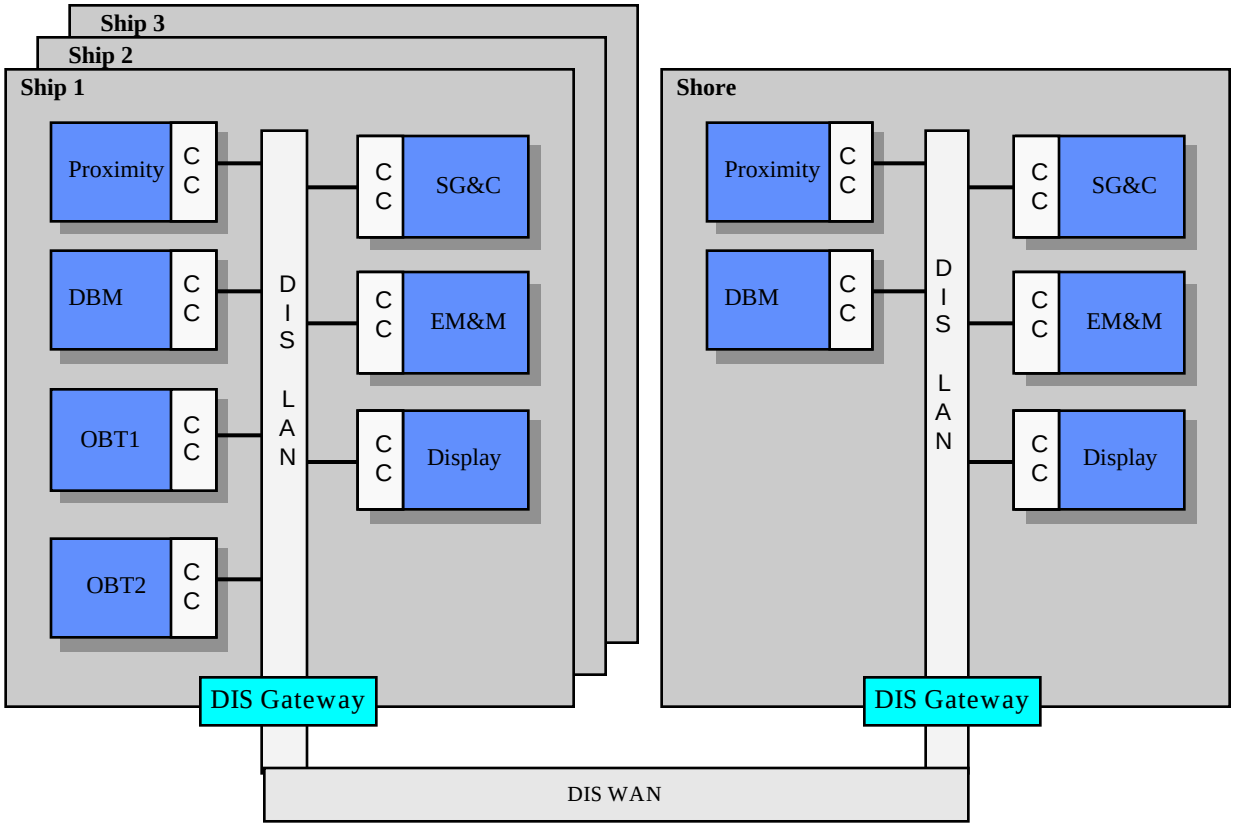
Current BFTT Functional Overview

CC - Common Communications Infrastructure

OBT - Onboard Trainer



HLA Implementation in BFTT

Goal: Interoperability

- DoD 5000.59 defines Interoperability for "M&S":

  "M&S Interoperability. The ability of a model or simulation to provide services to, and accept services from, other models and simulations, and to use the services so exchanged to enable them to operate effectively together."

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Goal: Interoperability

- BFTT must be interoperable with future HLA based Training Systems
  - HLA based communications infrastructure
  - Repository of Information / Components
    - Missions Space Definitions
    - Object Models
    - Previous FOM Data
    - Infrastructure Supporting Software
    - Site Infrastructure Data
    - Exercise Data
  - Scenario execution services
  - After Action Report processing

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Goal: Interoperability

- What Needs to change in BFTT to Transition from to DIS to HLA?
  - Minimum Change to be HLA Compliant
  - Minimum Change to Eliminate DIS
  - Maximize Reuse and Interoperability

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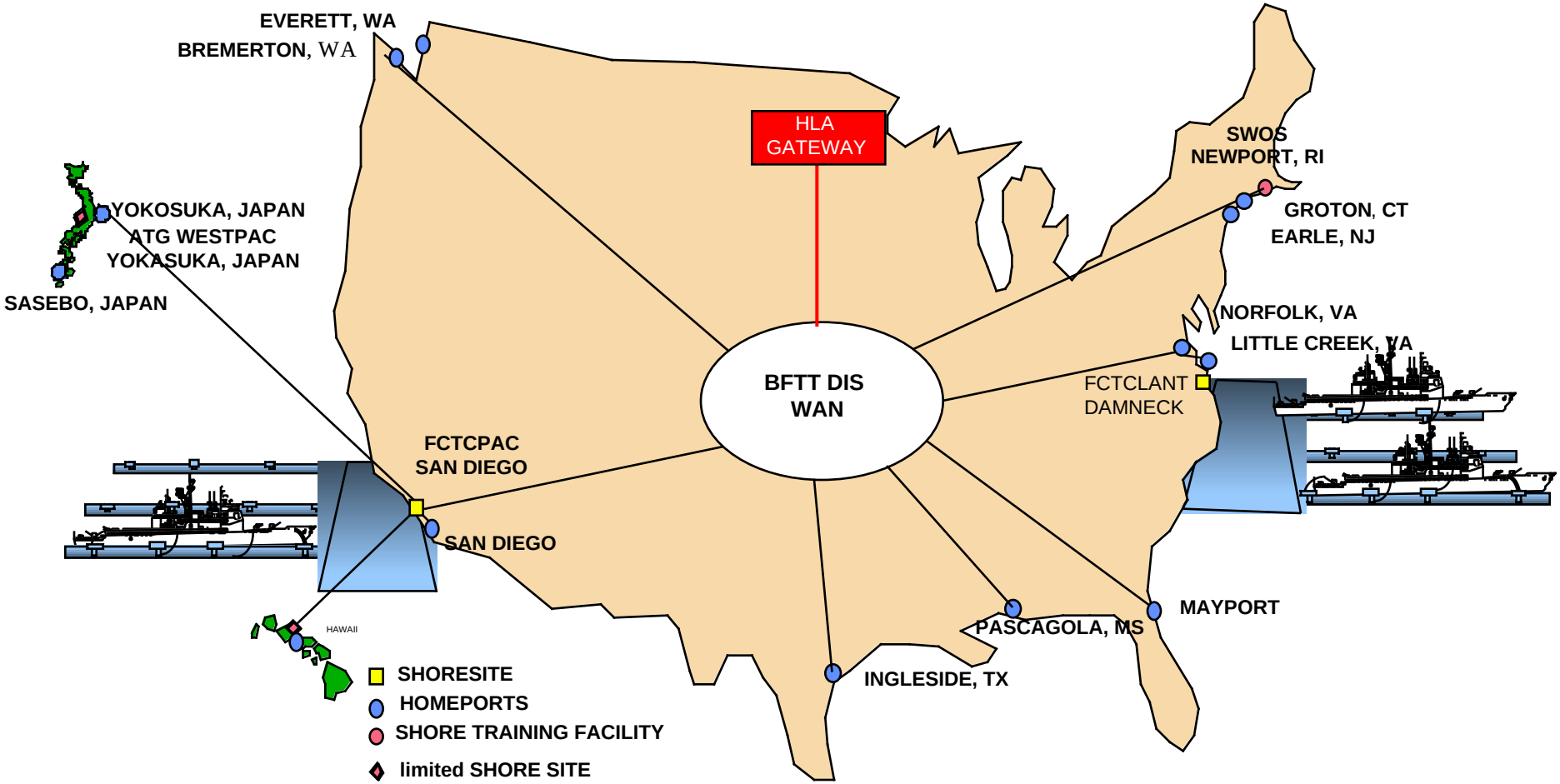
Single System Gateway

- **Physical location of the Gateway precludes using a single gateway option for multiple BFTT configurations**



HLA Implementation in BFTT

- HLA Implementation Options:
  - #1 - DIS / HLA Translator
  - #2 - HLA internal to BFTT Architecture
  - #3 - Full Adoption of HLA into BFTT

HLA Implementation in BFTT

Option #1 DIS/HLA Translator Key Features:

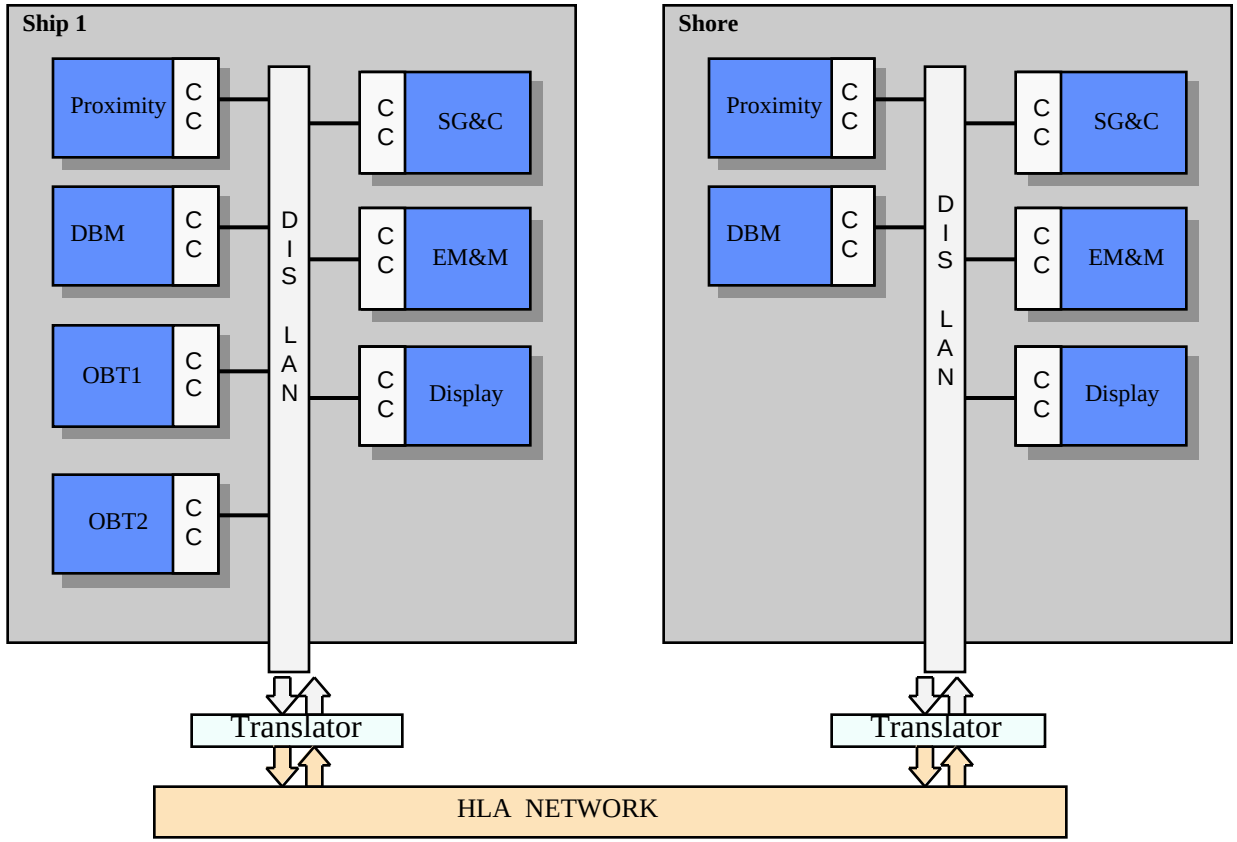
- Minimum Changes to be HLA Compliant
  - Each ship / shore site is a node for DIS / HLA translation
    - » Keeps DIS based messaging internal to OBTS
    - » HLA RTI between Ships

HLA Implementation in BFTT

Option #1 Architecture

CC - Common Communications Infrastructure

OBT - Onboard Trainer



Option 1

Interface Spec 1.0 Services That Cannot be Utilized

	Federation Management	Declaration Management	Object Management	~~Ownership Man~~agement	Time Management	Data Distribution Management
Translator Option	· Federation Save · Federation Restore	· Control Updates · Control Interactions	· Change Attribute Transportation Type · Change Attribute Order Type	· Request Attribute Ownership Devestiture · Request Attribute Ownership Assumption · Attribute Ownership Divestiture Notification · Attribute Ownership Acquisition Notification · Request Attribute Ownership Acquisition · Request Attribute Ownership Release · Query Attribute Ownership	· Request Federation Time · Request LBTS · Request Federate Time · Request Minimum Next Event Time · Set Lookahead · Request Lookahead · Time Advance Request · Next Event Request · Flush Queue Request · Time Advance Grant	· Create Update Region · Create Subscription Region · Associate Update Region · Change Thresholds · Modify Region · Delete Region

HLA Implementation in BFTT

Option #1 Analysis

- Pros:
  - Least Modification and Initial Cost
  - Provides HLA Compliance to the WAN level only
- Cons:
  - Limited Architectural Gain or use of HLA services
    - » BFTT STOW LAN remains DIS based messages
    - » No gain in entity capacity or filtering (Data Distribution)
    - » SOM remains based on DIS enumeration data models
  - Early Obsolescence
    - » DIS based FOM limits ability to support other / future FOMs
    - » Internal DIS Inhibits growth as OBTs become HLA compliant

HLA Implementation in BFTT

Option #2 - HLA internal to BFTT Architecture

Key features:

- Minimum Changes to Eliminate DIS
  - Replaces DIS based WAN and STOW LAN on ships and shore with HLA
  - Makes OBTs HLA compliant utilizing common S/W (CS)
  - Adds ORB interface to BFTT CSCIs utilizing the Common Interface Object (CIO)
  - Modifies Data Collection and Debrief processing to interface with HLA

HLA Implementation in BFTT

Option #2 - HLA internal to BFTT Architecture

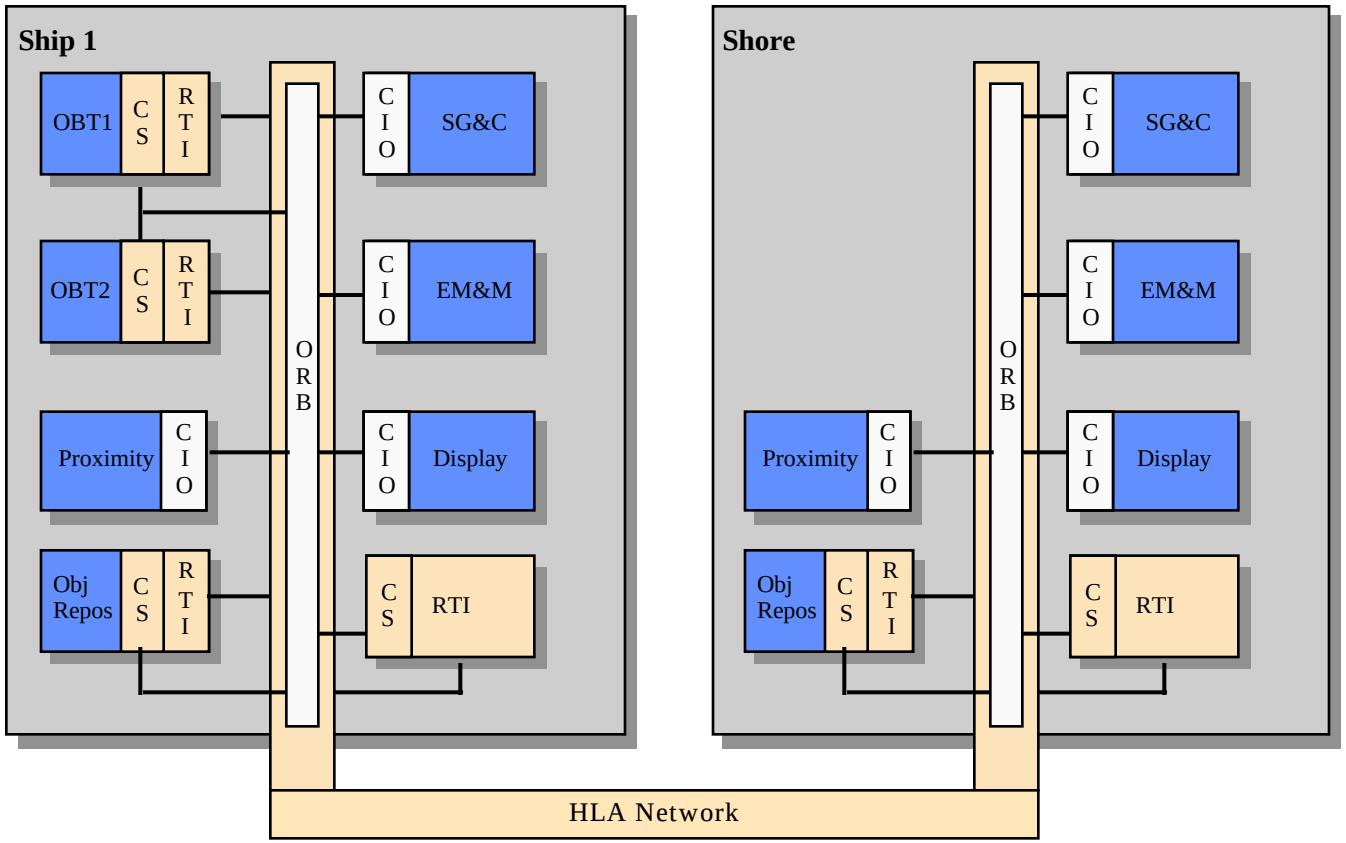
- **CS - Common Software**
- **CIO - Common Interface Object**
- **ORB - Object Request Broker**

Common Software

- Provides Persistence
- Provides Object updates and interactions, via the ORB, to any connecting CSCI's

Common Interface Object

- Set of Common Classes which interfaces with the Common Software via the ORB



HLA Implementation in BFTT

Option #2 Analysis

Interface Spec 1.0 — **Option 2**

Services That Cannot be Utilized

	Federation Management	Declaration Management	Object Management	Ownership Management	Time Management	Data Distribution Management
Internal HLA Option	· NONE	· NONE	· NONE	· NONE	· NONE	· NONE

HLA Implementation in BFTT

Option #2 Analysis

- Pros:
  - Limits Long Term Costs
    - » Abstracted many RTI functions (FOM, interfaces) which are expected to change
    - » Increases ability to reuse other simulation's object models
    - » Much of internal S/W & H/W unaffected
  - Eliminates DIS in BFTT
  - Allows potential use of all RTI services
  - New HLA compliant OBTs integrate directly
  - Reduces Bandwidth on WANs and LANs (filtering, subscribe)
- Con:
  - Increased Initial Cost compared to Option #1

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***Option** #3 - Full Adoption of HLA into BFTT Key Features:*

- Maximize Reuse and Interoperability
  - Replaces common communications infrastructure with HLA compliant interfaces
  - Each CSCI and OBT is made HLA compliant
  - Potential to reuse JWARS / JSIMS / JMIS object models and HLA software components

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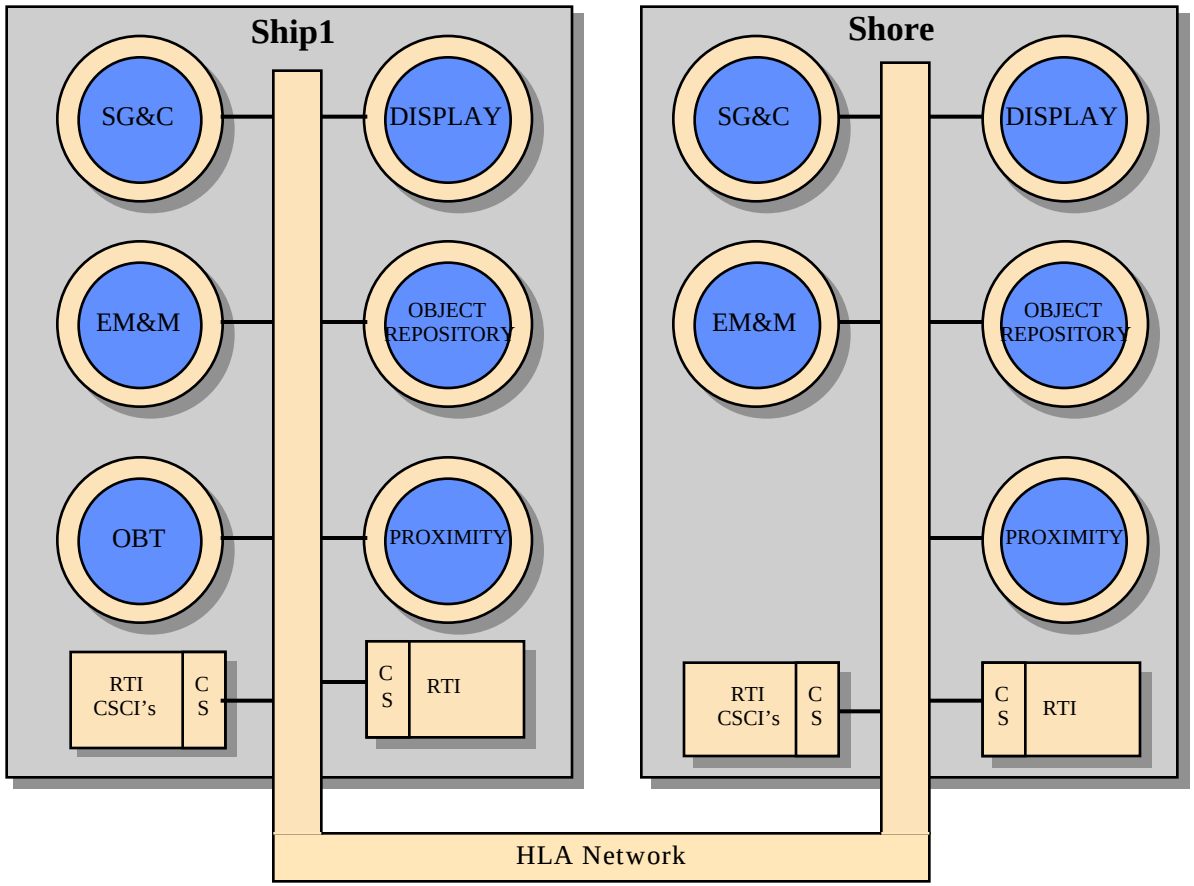
Option #3 - Full Adoption of HLA into BFTT



HLA Implementation in BFTT

Option #3 Analysis

Interface Spec 1.0 — **Option 3**

Services That Cannot be Utilized

	Federation Management	Declaration Management	Object Management	Ownership Management	Time Management	Data Distribution Management
CSCI Level HLA Option	· NONE	· NONE	· NONE	· NONE	· NONE	· NONE

HLA Implementation in BFTT

Option #3 Analysis

- Pros:
  - Allows maximum use of HLA flexibility for composability of federations and growth
  - Allows maximum reuse of other simulation program models, services and common S/W
  - Long Term cost Avoidance
    - » Engineering migration phases avoided
    - » Multiple Phased Ship installations avoided
- Cons:
  - Requires redesign of CSCIs
  - Highest Initial Cost

HLA Implementation in BFTT

Summary

- BFTT needs to adopt an Option that:
  - » Frees BFTT from DIS dependencies
  - » Reduces network loading
  - » Provides flexible architecture for future growth
  - » Maintains BFTT's software architecture
  - » Maximizes reuse of other simulation program object models and information
  - » Provides foundation for full interoperability with future federations